Notes on some Land-shells of the Pacific Slope. By J. G. Cooper, M. D.

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The recent publication of Vol. V of the "Terrestrial Air-breathing Mollusks of the United States," etc., by W. G. Binney, as a "Bulletin of the Museum of Comparative Zoology at Harvard College," forms a fitting occasion for making some further observations, biographical and taxonomic, on the species found west of the "Great Plains," which form the chief boundary within our limits between the eastern and western groups of species.

It is to be regretted that Mr. Binney has *not* had "time and inclination" to improve on the classifications of Albers and Von Marten, which his own original investigations have made quite inadequate to the subject (Preface, p. iii).

The many improvements made on the system adopted in the "Pulmonata Geophila," of Binney and Bland (Smithsonian Misc. Pub., 194, 1869), are very satisfactory, few of the errors there noted being retained in this work, which is to a great extent a republication of that, with additions from other sources, rendering it more complete as a manual of the subject. The bad results of the habit of blindly following foreign authorities is shown in the higher divisions adopted on p. 81, the first, *Agnatha*, being founded on a *negative* character as to the jaw, while those of the lingual teeth are not different in divisions B and C, and all of them show that these parts are insufficient for classification alone, while they lead to far more confusion of distinct forms than divisions founded only on external characters.

The labored investigations of the microscopists into the internal anatomy has at last led to nearly the same results as a comparison of external forms, as far as they prove a close connection to exist between the two groups of characters, and we may hope that the less difficult system of classification by external resemblances will in time resume its former importance, modified and improved by a knowledge of the *entire* structure of the animals. The fallacy of making family divisions to depend on a few internal characters has been often shown, and is becoming more and more certain with increase of investigation. I do not claim that the *shells* alone should guide in classification, but, with the form of the animal, they should define the higher groups, leaving the details of special organs to determine genera and species.

Genus Helix.

Again following his authorities Mr. Binney uses "*Helix*" as a comprehensive term, like Pfeiffer including in it every helicoid land-shell, and like the French naturalists making genera by distintegrating it without leaving a single original Helix. No other genus founded by the immortal Linnæus has so hard a fate, and it is to be hoped that at least *one* species will yet be found to be a Helix.

I have before shown that our west-coast banded group has claim at least to be considered first cousin to the type of Helix, and cannot yet see more than sub-generic differences, supposing *lapicida* to be the type. Mr. Binney, however, while admitting that the shell furnishes the most reliable characters for the division (p. 252), makes it subordinate in most genera, and appears to me to give it too little value.

Sub-genus Arionta.

I am more convinced by further comparisons of additional specimens that the group of forms of this sub-genus found around San Francisco Bay are merely local races of one species, the *californiensis* of Lea, running into the var. *nemorivaga* Val. (usually called *nickliniana* Lea, which however was so described as to include several), *bridgesi* Newc., passing into next, *ramentosa* Gld. (nearly = *reticulata* Pf.), and the extreme Monterey race *vincta* Val. (= *californiensis* of Binney).

A specimen from Cedar Mountain, east of San Francisco Bay, found by Dr. Yates, has nearly the form of var. *vincta*, being almost as high as wide, but much dwarfed. Occasional specimens occur within the range of each variety connecting it with some of the others. I suspect that the examination of numerous specimens of each would make the differences in internal characters pointed out by Mr. Binney less uniform than he makes them appear, as he admits much variation in these respects in several species thus examined.

The named varieties of the European *A. arbustorum* are even more distinct than in our group inhabiting the region around San Francisco Bay.

In the only admitted species of the Sierra Nevada, *A. tudiculata*, I have before mentioned that many varieties exist, though less localized and marked, only one having yet been named, the var. *cypreophila* Newc., MSS.; distinguished by thinness and umbilicus. This form, of very small size, was also found by Dr. Yates in 1875, at Shasta, Cal., near lat. 41°, the most northern point at which it has recently occurred. Nor does it pass east of the Sierra Nevada, though lately included in the shells of the Great Basin by Ingersoll, from misunderstanding the locality of "Bear River, Cal.," given by Carlton.

It may yet be proved that *A. arrosa* is but a sub-species of *californiensis*, the varieties *arboretorum* Val., and the later varieties *holderi* and *stiversiana* described by me, forming the connecting links. In that case *A. exarata* Pf. must also fall into the series, being connected with *arrosa* by intermediate specimens, though rare and local. But the very rarity of all these links tends to indicate an original difference in the chief forms, now becoming obscured where they meet in their ranges of distribution. (See Amer. Jour. of Conch., IV, 238.)

In a recent article I have shown by maps the peculiar distribution of the species I refer to, *Arionta* being grouped in narrow limits as compared with the others. (Proc. Cal. Acad. Sc., V, 121, 1873.)

Having now disposed of the Ariontas of the San Francisco group, there remain those of Southern California, and the islands, extending onto the peninsula. I have before shown in various articles that these are all con-

nected by intermediate forms, even that retained by Mr. Binney in genus *Euparypha* (*Tryoni*), the difference in this being merely the result of a greater abundance of lime in its food, and therefore in the shell. It is also not improbable that the species called *Euparypha* from southern Europe, etc., are merely *Arionta*e developed under similar conditions. In our species, however, I see no reason for allowing more than specific differences. Specimens of *H. kellettii*, and of var. *crebristriata* may be selected, and are more common fossil, that have just as much claim to be considered *Euparyphæ* (or of other genera) as *Tryoni*. No *single* character, external or internal, will suffice to distinguish genera in this family or order of animals.

A. redimita W. G. Binn. The author of this name now calls it "probably a variety of *A. ramentosa*," relying upon a resemblance in sculpture. But this file-like surface is characteristic of many forms in the young state, and of these species, the island variety first named *redimita*, shows in its form a much nearer approach to *A. kellettii* than any other, and much the same sculpture. The jaws and linguals are also nearer. A variety of *californiensis*, however, comes very near it in form, and was formerly mistaken for it on this coast.

I have before discussed the close gradations between the other southern species of *Arionta*.

Sub-genus Campylæa?

Retaining this name provisionally, I merely refer to my previous writings for the distinguishing characters between it and *Arionta*. The remarkable differences in the geographical distribution of the species, shown in the maps referred to, is among the most striking of their characters. It is quite probable that more thorough search in intermediate localities will tend to increase the number of connecting links, but as now known the species are more distinct than in *Arionta*, though a regular gradation in characters corresponding with their distribution has been already referred to.*

* With his characteristic devotion to European precedents, even where plainly wrong, Mr. Binney retains the name *Aglaia* (now as a genus) though long ago shown to be preoccupied twice in Mollusca. Besides it was used first for a South American shell of apparently distinct generic characters from ours. But because Albers long ago placed *H. fidelis* in this group. It is retained, with the subspecies or southern race *infumata*, and because the latter has a form like that of *H. hillebrandi*, Mr. Binney has put this also with them, ignoring the fact that this species bears exactly the same relation to *H. mormonum* as *H. infumata* to *fidelis*, and that intermediate specimens are even more common between the two first. *H. mormonum*, however, is an "*Arionta*" according to Mr. Binney!

Now any one with the shells before him can see a regular gradation from *H. hillebrandi* through *mormonum*, *sequoicola*, *dupetithouarsi*, *traskii*, *carpenteri*, *diabloensis*, *ruficincta*, to *gabbi* and *facta*. If one is an *Aglaia*, all are, the differences between this genus and *Arionta* being in the shells, though Binney's description does not make it at all clear. Having before pointed out the distinctive characters (Amer. Jour. of Conch., V, 201), I merely wish here to amend them by stating that I placed *H. carpenteri* in *Arionta* from misapprehension of its true characters, and that *diabloensis* as well as this, is probably a variety of *traskii*, although the form described by Binney as *diabloensis* appears to be a variety of *ramentosa*, of which he does not figure a type. The types, however, show an approach to *Arionta* as I stated in description.

A link connecting *fidelis* with *mormonum* found at the Dalles, Or., seems to me, however, most properly referred to the former. The most northern locality for *mormonum* now known is at Shasta, Cal., lat. 41° (nearly), alt. 1160 feet, where in the volcanic region Dr. Yates found a very few stunted specimens with but five and a half whorls and the bristle-granulations of the young very strongly developed.

H. dupetithouarsi Desh. The figure copied by Binney from Deshayes, if accurately drawn, is larger than any Monterey specimen I have seen, although Deshayes gives that as the locality. It also has two black bands alternating with three light ones, thus appearing more like the variety of *fidelis* with a light upper surface, while the character "lighter above," also suits that rather than the Monterey shell. As Dupetithouar's expedition visited Oregon, I suspect that Deshayes really figured a *fidelis* as a better example of the species, not having seen Gray's nor Lea's then recent descriptions, just as he overlooked Conrad's of marine species collected by Nuttall in California.

Still as he gives only Monterey as the locality, the name had better remain with that species which the description suits (with the exceptions here noted in color and size).

This confusion may account in some degree for authors confounding with this species others from distant points, and thus giving it an enormous instead of very limited range. Some late authors have also obtained it at second hand from amateur collectors on this coast, who, although getting it directly or indirectly from Monterey, thought it only a finer variety of the banded snails of their own vicinities, and thus gave it as a generally diffused species.

H. fidelis var. *infumata*. Mr. Binney does not refer to the evidences given by me for making this a variety, nor to its ranging 36 miles south of San Pablo Bay.

H. sequoicola Cp. This local race has characters connecting *fidelis*, *mormonum* and *dupetithouarsi* in about the degrees by which it is distant from their ranges. Mr. Binney's description, from a somewhat faded specimen, differs some from that of the types. Only the young shell is bristly up to five whorls, thus longer than in *traskii* and *mormonum*. His figure of *traskii* is from a small, probably stunted variety, as it grows a third larger. That of *diabloensis* is also from an immature specimen, if not a typical *ramentosa*. The colors of the animal of *mormonum* are described by him as different from that seen by me, but as the shells differ much in color, the animals may also in various localities of its long range. (See Proc. Cal. Acad. Sciences, VI, 1875, 18.)

H. rufocincta Newc. I spent several weeks on Santa Barbara Island, and examined it carefully for helices, finding thousands of some species, but none of this, so that I think the large race mentioned by Binney must have been from Catalina Island, where alone I found it, varying much in size. I was wrong also in referring the San Diego shell to this, as it has since been generally considered *carpenteri*. I have before stated the close resem-

blance in everything but small size of *H. gabbi* to this species, which it seems closer to than to *H. facta* with which Binney unites it.

As confirming the near relation of this group to *Campylæa*, it is notable that Mr. Binney mentions "*Campylæa*" *lapicida* (p. 379), which is so similar to our angled species. If not the type of Helix, the name *Helicigona* Risso, 1826, is, however prior, if the MSS. name, *Chilotrema* Leach, is rejected.

MESODON Raf.

M. townsendianus Lea. The internal characters of the animal certainly connect this species more nearly with *Mesodon* than *Arionta*, and the shell confirms this connection. Its more developed and reflexed lip, with the lower lip furnished with a "careniform tooth" is typical, while a little resemblance in sculpture is all it shows in common with *Arionta*.

M. (*Odotropis*) *devius* Gould. In that interesting locality, Shasta, California, Dr. Yates also found a dwarf variety of this species only about $\frac{4}{10}$ of an inch wide, and with only five whorls, evidently the Southern stunted race of this Northern species, nearly like Rocky Mountain specimens. Mr. Binney is certainly wrong in calling the bristly and three-toothed *Triod. mullani*, a variety of this species, though examples with faint teeth may look much like dwarfed *devius*. He unites them on p. 338, but on p. 432 shows that the jaws and teeth differ very much. On the same grounds I might call the Shasta specimens *loricata* as they approach it in size and form, or we might make half the Eastern *Triodopses* varieties of *Mesodons*.

"*Triodopsis*" *harfordiana* Binney, not Cooper, p. 309. The shell here described and figured is certainly not my shell, but seems a variety of *T. mullani*, the differences described in jaw and linguals not being so great as in *mullani* and *devius*. My shell differs in the flat spire, unreflexed lip, wider umbilicus, and 6 (not 4) whorls. In his arrangement it would be a *Polygyra* near *P. triodontoides*, and is very unlikely to range in the direction of Idaho.

Mesodon (*Aplodon*) *columbianus* Lea. I am satisfied that the examination of a few more animals of the toothed and imperforate form found in California, which so much resembles a large *germanus*, would prove to Mr. Binney's satisfaction that there is a regular gradation in the number of ribs on the jaws from 8 to 11, as stated recently by myself. Whether the genitalia constantly differ as described in Oregon specimens, requires further comparisons of fresh as well as alcoholic examples.

The list on p. 18, would suggest that both these species extend to San Diego, though really not found as yet south of lat. 36°, if so far.

GLYPTOSTOMA Binney and Bland.

The form of jaws alone is allowed to locate this near *Helix*, though most of its characters seem to indicate a nearer affinity to *Patula*.

PATULA Held.*

Mr. Binney now unites *P. cooperi* with *P. strigosa*, but on the same grounds should make all the species of the Central Province varieties of

*The great differences in jaws of "*Patula*" show that this organ must be considered inferior to external form, &c., in classification.

solitaria. The evidence from intermediate forms, is like that in the case of the *Ariontæ*, and yet the intermediate specimens are scarcely numerous enough to determine them as mere varieties, while he finds the teeth differ considerably. The fact that *solitaria* occurs as far west as near Vancouver, W. T., and near the localities of *strigosa*, at the Dalles (which is within the Central Province), without mixing, tends to prove distinctness of species in some degree. Future investigation of climatic peculiarities may determine the cause of some local variations.

The *Patula* from Alaska *referred* by me to *P. ruderata* with *a* (?), in the Amer. Jour. of Conch., V, 202, was certainly not *P. pauper* Gould as I at the time stated, and the diagnosis I gave then would distinguish them perfectly, yet Mr. Binney assumes that the Asiatic species is the same; though differences exist between them nearly as great as between *P. idahoensis* and *P. alternata!*

Macrocyclis Beck.

It is not yet determined that the Chilian type of this genus (*M. laxata*) is congeneric with our species, which may yet prove to require the name *Mesomphix* Raf (type *concava* according to Ferussac).

On p. 90, Mr. Binney followed my former statement that *M.? vancouverensis* did not extend S. of lat. 37°, though in Amer. Nat., Jan. 1873, I stated that I found it common near San Diego, and I have seen specimens from Central America, exactly similar (*vellicata* Forbes?).

Zonites Gray, not Montfort. The original type of this genus, *algira*, appears to be very distinct from the thin diaphanous species, belonging to *Hyalina* Fer, though *Omphalina* Raf. (type *cuprea-fuliginosus* Griff., MSS.), may possibly have precedence.

Mr. Binney gives "*Z. nitidus*" as found at Astoria, Oregon (p. 114), and "*Z. cellarius*" as from Astoria, N. Y. If no confusion of localities has occurred, the former is just as likely to have been introduced on ships, as the latter, and not to be really circumpolar.

There appears to be an error, either in the dimensions given or the scale showing size of "*Z. stearnsii*," p. 128. Other probable errors of this kind occur in the book, among them a repetition on p. 360 of 31 millimetres for 21, the actual breadth of the type fig. of *A. redimita*. The want of a uniform scale of enlargement of minute species, is to be regretted.

Ariolimax Mörch.

The figures given from alcoholic specimens have almost no value in comparing the outlines of the species, as they vary much, according to the degree of contraction of the animal, either when dropped in, or afterwards on account of the variable strength of the spirits used to preserve them. This variability also affects the form of internal organs, though in less degree, but probably enough to account for some of the differences described in viscera, though not those in jaws and linguals.

The figures given of *A. hemphilli* and *A. andersoni* show only such differences as can be found in a number of any one species put in alcohol

under varying conditions, and are thus undistinguishable from examples of *A. niger*. Of the value of the differences in jaws and teeth, it will require comparison of many from various localities to decide.

The species however, is *A. andersoni* W.G.B. not *Prophysaon andersoni* J. G. Cooper, sp.

Living specimens of these forms differ from *A. niger* only in pale colors, but all the slugs vary so much in this that it is an unreliable character.

Prophysaon W. G. Binney.

The figure given of *P. hemphilli*, represents exactly the alcoholic appearance of my *Arion? andersoni* (p. 236), and the description is conformable, allowing for difference in this respect. Still the internal differences observed, may distinguish the northern form until fully compared with the southern.

In my MSS. description, I remarked on the differences from *Arion*, and suggested the name *Limacarion*, which some friend suppressed in printing, probably thinking it preoccupied. I still have specimens so labelled at the time of writing. At any rate *Prophysaon andersoni* has priority, as a specific name over *P. hemphilli*.

On p. 239, Mr. Binney refers to the *fresh* specimens sent by me to him, but tries to find a discrepancy in my statement that it has a caudal mucous pore. I still think that it has one, but so small as to be imperceptible when contracted by alcohol. This "mucous pore" continues to be a great stumbling block in classification, although it only differs in degree of development in various genera. All of them are covered with mucous glands as in *Limax*, each gland with a pore opening externally, and the caudal gland merely varies in size. No more mucus is produced by *Ariolimax* than by a *Prophysaon* or *limax* of the same size. The large cavity under the mantle as figured by Binney, is rather a notch between it and the end of the foot, than the opening of an enormous gland. In describing *Arion foliolatus*, Dr. Gould calls it a *pit* which tends to prove that form to be an *Ariolimax*.

Besides this character the position of the spiracle in my figure of *A.? andersoni* was sufficient to prove to Mr. Binney that it was not an *Ariolimax*, so that there was no need of making confusion by applying the name of my species to one of that genus.

The number of ribs on the jaw seems variable with age, and as I described the largest specimens, I found more than given by Binney in any of them. In some cases also, two or more ribs appear consolidated into a wide one, and the lateral ribs are rudimentary.

In quoting my locality of Santa Barbara for *A. columbianus* Mr. Binney does not consider that I afterwards separated *A. californicus* from that species, and that the extreme southern specimens are most likely to be the latter, if not a new form.